COSEWIC
Status Appraisal Summary

on the

Round Hickorynut
Obovaria subrotunda

in Canada

ENDANGERED
2013

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

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For additional copies contact:

COSEWIC Secretariat
c/o Canadian Wildlife Service
Environment Canada
Ottawa, ON
K1A 0H3

Tel.: 819-953-3215
Fax: 819-994-3684
E-mail: COSEWIC/COSEPAC@ec.gc.ca
http://www.cosewic.gc.ca

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COSEWIC
Assessment Summary

Assessment Summary – May 2013

Common name
Round Hickorynut

Scientific name
Obovaria subrotunda

Status
Endangered

Reason for designation
The Canadian population of this species has declined by 75-95% over the last 10 years, with an estimated 99% decline over the last 30 years. Populations in the Grand and Thames rivers are extirpated and populations in the Sydenham River and Lake St. Clair have declined to very low levels. Losses and declines are due to the combined effects of pollution from agriculture and residential runoff, and the impacts of invasive species like the Zebra Mussel.

Occurrence
Ontario

Status history
Designated Endangered in May 2003. Status re-examined and confirmed in May 2013.

COSEWIC
Status Appraisal Summary

Obovaria subrotunda
Round Hickorynut — Obovarie ronde
Range of occurrence in Canada: ON

Status History:

Designated Endangered in May 2003. Status re-examined and confirmed in May 2013.

Evidence (indicate as applicable):

Wildlife species:

Change in eligibility, taxonomy or designatable units: yes ☐ no ☒

Explanation:

There has been no change to the formal taxonomy and the Canadian population of *Obovaria subrotunda* remains as one designatable unit. The recognized authority for the classification of aquatic molluscs in the United States and Canada is Turgeon *et al.* (1998)

Range:

Change in Extent of Occurrence (EO): yes ☒ no ☐ unk ☐
Change in Index of Area of Occupancy (IAO) : yes ☐ no ☒ unk ☐
Change in number of known or inferred current locations:* yes ☒ no ☐ unk ☐
Significant new survey information yes ☒ no ☐

Explanation:

The Round Hickorynut was reported historically from the Detroit, Grand, Thames, Sydenham and Welland rivers and lakes Erie and St. Clair in Ontario. The recalculated, historical EO, including records from 1890 to 2012, is 31,198 km^2 (Figure 1). By 2001, the species still occurred in the East Sydenham River and portions of the Lake St. Clair delta and had an EO of 1502 km^2 (COSEWIC 2003 stated ~1705 km^2 but the value was recalculated for this update). The historical recalculated decline to 2001 is estimated at 95% and the species was declared as likely extirpated from offshore waters of Lake St. Clair, Lake Erie, Detroit River, Thames River (excluding one fresh whole shell at each of two sites), and Grand River (COSEWIC 2003). Since 2001 the Round Hickorynut was not found in surveys in new sites in the offshore waters of Lake St. Clair, Lake Erie, Detroit River, Thames River (excluding one fresh dead valve found in 2005), and Grand River but continued to be found in Lake St. Clair Delta and the Sydenham River (see **Population Information**); the current EO is 120 km^2 (Figure 2), which represents a further decline of 92% since 2001, or an overall decline of 99%.

The historical IAO (1890 to 2012) using a 2 km x 2 km grid was recalculated as 164 km^2, but it includes large areas of land (Figure 3); in 2001 the AO, which included only waters occupied by the species, was stated as 8 km^2, which included a portion of the Lake St. Clair delta and a portion of the Sydenham River (the latter declared incalculable, COSEWC 2003). The current IAO (2002 to 2012) using a 2 km x 2 km grid is 24 km^2 (Figure 4). Because the same sites were occupied for portions of the period 1991 to 2001 and for portions of the period 2002 to present, the IAOs are probably similar

for the two periods, even though the data suggest a change in IAO.

The number of locations is one to two. The Sydenham River is a major tributary of the Lake St. Clair and contributes some severe threats, especially pollution from agricultural and road runoff into Lake St. Clair. Lake St. Clair also contributes invasive species, especially Round Goby (*Neogobius melanostomus*) that is pervasive throughout the lake and much of the Sydenham River.

* Use the IUCN definition of "location"

Population Information:

Change in number of mature individuals:	yes ☒ no ☐ unk ☐
Change in total population trend:	yes ☒ no ☐ unk ☐
Change in severity of population fragmentation:	yes ☐ no ☒ unk ☐
Change in trend in area and/or quality of habitat:	yes ☒ no ☐ unk ☐
Significant new survey information	yes ☒ no ☐

Explanation:

Obovaria subrotunda has not been found in Lake Erie since 1991, largely due to the invasion of the Zebra Mussel (*Dreissena polymorpha*) (Mackie and Claudi 2010). No shells, living or dead, were found during two surveys from July 11-13, 2005, one in Mosquito Bay off Pelee Island after 1.5 person-hours of snorkelling and the other after searching Holiday Beach Conservation Area (effort unknown).
Round Hickorynut has not been found in the Grand River since 1885 (COSEWIC 2003). Ten surveys in the lower Grand River from 1935 to 1988 yielded no live Round Hickorynuts (DFO unpubl. data). A small survey (16 m^2) at York, ON August 20, 2010 did not reveal any living Round Hickorynuts (Mackie 2010d). More recently, sediments were excavated at 11 sites (2100 m^2) in the upper Grand River between 2007 and 2009 and no Round Hickorynut shells were found (Mackie 2006a, 2007a,b, 2008a, 2009, 2010b). These extensive searches support the assumption that the species is extirpated from the upper and lower Grand River.

Only three live individuals (one from each of three sites) were collected from 1995 to 2001 after 200 person-hours (p-h) of survey effort in the Sydenham River, whereas 32 live specimens had been found at 11 different sites in the East Sydenham River (DFO unpubl. data; COSEWIC 2003) over this period. A total of 15 sites using 4.5 p-h/site were surveyed in the East Sydenham River between 1991 and 2001 and seven live specimens were found. Four sites with 4.5 to 42 p-h/site were surveyed from 2002 to 2009 and one live *O. subrotunda* was found in 2002; a quantitative survey was carried out at Alvinston in 2003 and only one weathered valve of the species was found; in 2007 no living Round Hickorynut were found after 8 p-h; in 2008, 42 p-h were spent in the East Sydenham River at Wallaceburg and four species were found but no shells of *O. subrotunda* (Mackie 2008b). In 2009, 8 person-hours of searching in the river at Croton yielded one weathered valve but one live individual was found on 8 August 2012 at Croton. It is probable that the species is in imminent danger of extirpation from the East Sydenham River, where the Round Hickorynut represented approximately 0.0024% of the mussel community up to 2001 (Fisheries and Oceans Canada (DFO 2013)).

The Round Hickorynut is deemed to be extirpated from the Thames River since the turn of the century (COSEWIC 2003), although one fresh whole shell was found in 2001, one fresh dead valve was found in 2002, and one dead weathered valve was found at a First Nation site in 2005 (DFO unpubl. data 2012). Several mussel surveys/relocations involving excavation of sediments have been done in the Thames River since 2004 and no Round Hickorynuts were found (relocations involve excavating sediments down to 10 cm with 1-m^2 quadrats) at: (1) Airport Road in London, Ontario in 2004 (total 84 person-hours, 900 m^2); (2) 27 sites were surveyed in the Upper Thames River and 10 sites in the Lower Thames River in 2004 and 2005 (Morris and Edwards 2007); (3) excavation of a total of 3679 m^2 at 13 sites in Medway Creek (tributary of Thames River) in 2006, 2007, and 2010 (Mackie 2006b,c, 2007a, 2010a); (4) excavation of 270 m^2 at 4 sites on the Thames River at Fish Creek and Flat Creek in 2010 (Mackie 2010c); (5) excavation of 1059 m^2 at 3 sites in Dorchester in 2011 Mackie (2011).

The Lake St. Clair delta population is the healthiest but has been declining since the arrival of the Zebra Mussel in 1986. Unionids had been virtually extirpated from the southwestern nearshore waters of the lake by 1992 (Gillis and Mackie 1994) and the offshore waters between 1988 and 1997 (Nalepa and Gauvin 1988; Nalepa *et al.* 1996; Nalepa *et al.* 2001). Zanatta *et al.* (2002) surveyed 31 sites in the delta of Lake St. Clair from 1999 to 2001 and found 22 species, including 53 live *O. subrotunda* in five of the sites; the mean density of unionids in their survey varied from 0.03 to 0.07 mussels/m^2; 15% of the mussel community was *O. subrotunda*, giving a mean estimate of 0.008/m^2 in 2001. Metcalfe-Smith *et al.* (2004) resurveyed the St. Clair delta in 2003 and found only nine live Round Hickorynut during sampling of nearly 5000 m^2, or 0.002 *O. subrotunda*/m^2. The population was dominated by relatively large, older individuals, indicating poor reproductive success with the possibility of frequent year-class failure (Metcalfe-Smith *et al.* 2004). An unpublished data set from DFO recording distributions for Round Hickorynut from 2003 to 2011 was also examined; in 2003 six sites (at 65 m^2/site) near Bassett and Squirrel islands yielded 10 *O. subrotunda*, or 0.026 mussels/m^2 after snorkelling areas where at least one live mussel (any species) was found at each site. Many dead *O. subrotunda*, along with six other species, were found in Chematogan Bay in 2003; the average Zebra Mussel infestation rate at the site was the highest measured, 35.5 per unionid (St. Dev. = 57) (McGoldrick pers. comm. 2012). Only one live specimen was found in 2005 in Chematogan Bay after snorkelling 4 p-h. In 2004, 35 live Round Hickorynuts were found in Bass Bay for a relocation study (search effort unknown), but in 2011 in the same area only two Round Hickorynuts were found after searching about 5000 m^2 or 0.0004/m^2.

In summary, based on the DFO data above, the estimated rate of decline from 2003 (0.026 *O. subrotunda*/m^2) to 2011 (0.0004 *O. subrotunda*/m^2) is 98.5%. Based on these data the estimated trend in decline of Round Hickorynut in the last 10 years is between 75% and 95%, which yields a 99% overall historical decline. This increase in rate of decline since 2001 implies continuing decline of habitat quality, extent and area.

Threats:

Change in nature and/or severity of threats: yes ☒ no ☐ unk ☐

Explanation:

A threats calculator (Appendix I), done by the report writer and reviewed by the Molluscs SSC which includes the Chair of the Recovery Team, was used to rank threats. Fisheries and Oceans Canada (DFO 2013) also did a threats analysis based on their expected relative impacts, spatial extent, frequency, expected severity and causal certainty; the IUCN/COSEWIC threats calculator results agree with the DFO assessment. Most of the threats reported in COSEWIC (2003) continue to degrade habitat extent and quality, some at an apparent accelerated rate. Based on the IUCN/COSEWIC threats calculator (numbers refer to those in Appendix 1), the threats can be summarized from very high to low and negligible impact threats into eight categories. Two are very high impact threats: <u>pollution</u> (9, urban waste water, industrial and agricultural pollution) and <u>invasive species</u> (8, dreissenids and Round Goby). One is a high impact threat: <u>climate change</u> (11, water quantity) and one has a medium impact: <u>transportation & service corridors</u> (4, shipping lanes). Another one is ranked as a medium to low impact threat: <u>biological resource use</u> (5, declines in host fishes). Two are ranked as low impact threats: <u>energy production and mining</u> (3, oil drilling) and <u>human intrusions & disturbance</u> (6, physical habitat loss/modification by ATV activities) and one threat, <u>agriculture with livestock farming</u> (2, cattle in streams), has a negligible impact.

<u>*Pollution*</u>: runoff from streets carries polyaromatic hydrocarbons and other organic contaminants; sediments; thermal pollution received by Lake St. Clair from the Sydenham River. Agriculture accounts for 75-85% of land use in the Thames River basin; tile drainage, wastewater drains, manure storage and spreading, and insufficient soil conservation have all contributed to poor water quality within the Sydenham and Thames basins (DFO 2013). The watershed of Lake St. Clair is 75-85% agriculture and the Sydenham River, which empties into Lake St. Clair, contributes suspended material.

Juvenile mussels are among the most sensitive aquatic organisms to ammonia toxicity (Mummert *et al.* 2003; Newton 2003; Newton *et al.* 2003; Newton and Bartsch 2007). The Sydenham River has historically shown high nutrient and phosphorus levels that have regularly exceeded provincial water quality levels

over the last 30 years (Staton *et al.* 2003). The potential risk that copper poses to mussel populations was assessed by Gillis *et al.* (2008, 2010) by comparing copper and dissolved organic carbon concentrations from significant mussel habitats in Ontario to the 50% effective concentration for *Lampsilis fasciola*, another mussel species. Although overall mean copper concentration in the mussel's habitat was well below the acutely toxic level given the concentration of dissolved organic carbon, episodic copper releases in low dissolved organic carbon waters may be a concern for the recovery of endangered freshwater mussels (Gillis *et al.* 2010).

Southern Ontario is riddled with road ways and levels of toxic chemicals, like chloride, have increased due to an increased use of road salt (Staton *et al.* 2003). Chloride levels in the Sydenham River have been reported at levels greater than 1300 mgL^{-1}, which were shown to be toxic to glochidia of the Wavyrayed Lampmussel, *Lampsilis fasciola*, given the right calcium hardness conditions (Gillis 2011); considering the density of road ways in southern Ontario, chloride is likely a huge threat to the early life stages of freshwater mussels.

The overuse of herbicides and pesticides, release of urban and industrial pollution into rivers, nutrient loadings from fertilizers, municipal wastewater and domestic septic systems, and roadway runoff that contains salts, heavy metals, polyaromatic hydrocarbons, etc. are all a result of urbanization and can alter water chemistry affecting habitat and host fish availability for the Round Hickorynut (DFO 2013). Gagné *et al.* (2004, 2011) and Gagnon *et al.* (2006) showed that exposure to municipal effluent containing pharmaceuticals can negatively affect unionid health by disrupting gonad physiology and reproduction of this species.

Invasive species: The Zebra Mussel is of particular concern in lakes as well as rivers as long as there is an upstream impoundment that has a retention time greater than 21 days (Mackie and Claudi 2010). These invasive mussels are known to cause death to unionids (Mackie and Claudi 2010). Richness and abundance of unionids had declined dramatically between 1986, when the Zebra Mussel arrived, and 2001 when *O. subrotunda* was first assessed (COSEWIC 2003) and continued to decline from 2001 to 2011 (see **Population Information**). At least 50% of the decline in Round Hickorynut in Lake St. Clair is attributed to the invasion of Zebra Mussel (DFO 2013, see also **Population Information**). The only unionids to survive the mussel invasion in Lake St. Clair are those in the delta (DFO 2013) but they are declining rapidly and may not persist for long (McGoldrick *et al.* 2009). There are no Zebra Mussels in the Sydenham River (North or East) and they are not likely to survive because there are no large impoundments on the river.

The Round Goby is a new threat and this fish is threatening many host fish of unionids in the entire lower Great Lakes and its tributaries by competing with other benthic fish and feeding on their eggs and juveniles (Poos *et al.* 2010). Declines in populations of native benthic fish species that are hosts for many mussel species at risk include Logperch (*Percina caprodes*), Mottled Sculpin (*Cottus bairdii*), Johnny Darter (*Etheostoma nigrum*), Trout-perch (*Percopsis omiscomaycus*), Fantail Darter (*E. flabellare*), and Greenside Darter (*E. blenniodes*) in the St. Clair River (French and Jude 2001) and Lake St. Clair (Thomas and Haas 2004). Poos *et al.* (2010) estimated that 89% of benthic fishes and 17% of mussels that occur in rivers where the secondary invasion of the Round Goby has occurred have been or will be negatively impacted; in particular, Poos *et al.* (2010) reported Round Goby in the Lake St. Clair delta and lower portions of several rivers including the Sydenham River between 2003 and 2008, suggesting that upstream invasion was in progress. Tremblay (2012) successfully infested Round Goby with three mussel species that metamorphosed on two at risk mussels (*E. triquetra, V. iris)* but at low rates. Approximately 39.4% and 6.3% of Round Goby collected from areas of unionid occurrence in the Grand and Sydenham rivers (Southwestern Ontario) had body burdens of glochidia, respectively. The results indicate that *N. melanostomus* serves more as a sink for glochidia than as a host for unionids, and suggests a novel way in which *N. melanostomus* is affecting native species. The increased spread of the Round Goby thus poses a real threat to host fish populations and could devastate remaining mussel populations by disrupting their reproductive cycle (DFO 2013).

Climate change: Climate changes can alter the quantity of water which can dislodge mussels from areas of suitable habitat into areas of marginal habitat during high flows and depress dissolved oxygen levels,

elevate stream temperatures, and cause desiccation during low flows. Spooner *et al.* (2011) examined how anticipated shifts in water flow would affect affiliate species–discharge relationships (SDR) and impact co-extirpations of mussels and fish. They found that the strength and predictability of SDR models varied geographically with the patterns of extirpations strongest in the southeastern US where: (a) flow reductions are expected to be greatest; (b) more species are lost per unit flow; (c) and more mussels are expected to be lost per unit of fish. Moreover, overall mussel losses associated with reduction in water availability were greater than losses of fish hosts.

Transportation & service corridors: Dredging can result in the direct destruction of mussel habitat and lead to siltation and sand accumulation of local and downstream mussel beds. Dredging is done frequently in the Lake St. Clair shipping channel; 30,500 cubic yards of shoals from the shipping channel were to be dredged in 2010 (Dredging News Online 2010).

Biological resource use: The Round Hickorynut is an obligate parasite unable to complete its early life stages without a suitable host. McNichols (2007) identified three potential host species for the Round Hickorynut: Blackside Darter (*Percina maculata*); Fantail Darter (*Etheostoma flabellare*); Iowa Darter (*E. exile*). An association between the Round Hickorynut and the Eastern Sand Darter (*Ammocrypta pellucida*) suggests a possible host relationship (DFO 2013) but this fish has not been tested to see if it can act as a host. The Eastern Sand Darter Ontario population can be found in the East Sydenham River where the Round Hickorynut still persists. The COSEWIC (2010) report on this fish cites numerous threats to the species, and the recovery strategy (DFO 2013) ranks the status of the population in the Sydenham River as poor. Siltation from agricultural activities has been cited as one of the main reasons for the decline of the Eastern Sand Darter (Holm and Mandrak 1996).

Energy production: In 2006 there were 1045 active oil wells with about 100 new oil and gas wells drilled in southern Ontario each year (OMNR 2011). Wells no longer used for the purpose for which they were drilled or wells that do not produce oil or gas must be plugged according to provincial standards under the *Oil, Gas and Salt Resources Act* and the surface must be rehabilitated; on average 100 depleted wells are plugged every year (OMNR 2011). Plugging is to be done as soon as possible after the well is taken out of service. Fluids escaping from the well will kill vegetation, create unusual wetness, and possibly leak sulphur water creating hydrogen sulphide odour (OMNR 2011). Clearly there is potential, albeit low, for oil contamination of surface and/or ground waters.

Human intrusions & disturbance: Included here are in-stream recreational activities, like ATVs running up and down streams.

Agriculture with livestock farming: The Sydenham and Thames rivers are two large tributaries of Lake St. Clair and agriculture is pervasive in both rivers with over 85% of the land in the Sydenham River watershed in agricultural use, of which 60% is tile drainage (Dextrase *et al.* 2003). Cattle frequently enter the streams likely trampling many mussels.

Protection:

Change in effective protection: yes ☐ no ☒

Explanation:

The species was assessed as endangered by COSEWIC in 2003 and was placed on Schedule 1 of SARA and on SARO (Species at Risk in Ontario). The species does not receive habitat protection under SARA at this point in time, only species protection. The federal *Fisheries Act* historically represented the single most important piece of legislation protecting the Round Hickorynut and its habitat in Canada. However, recent changes to the *Fisheries Act* have significantly altered protection for this species and it is unclear at this time if the *Fisheries Act* will continue to provide protection for this species. The species was listed under Schedule 3 of Ontario's *Endangered Species Act*, 2007 (ESA) and receives species protection under this Act, but will not receive habitat protection until June of 2013.

Rescue Effect:

Change in evidence of rescue effect: yes ☐ no ☒

Explanation:

The SRanks of the species in the U.S.A. are: SX in Illinois; S1 in Arkansas, Indiana, Michigan, Pennsylvania; S2 in Alabama, Mississippi: S3 in West Virginia; S4 in Ohio; SH in Georgia, New York; S2S3 in Tennessee; S3S5 in Kentucky. The Round Hickorynut is currently listed as endangered in Illinois, Michigan, and Alabama (and proposed for endangered in Pennsylvania), threatened in Tennessee, and special concern in Indiana, and is therefore afforded some protection in these states.

The nearest Round Hickorynut populations in the U.S.A. are in Michigan. In 2011-2012, a group based out of Central Michigan University spent over 250 person-hours examining coastal wetlands, embayments, and drowned river mouths on the US shores of Lake Erie (MI, OH, PA, and NY) and found no sign of live *O. subrotunda*; at best they found only a few ancient shells (Zanatta pers. comm. 2013). It also is not likely that rescue will occur from Illinois populations. Rescue could occur from tributaries of Lake St. Clair in Michigan because *O. subrotunda* occurs in Clinton River (Morowski *et al.* 2009) and Belle River in the St. Clair River drainage (Zanatta pers. comm. 2012). Evidence of gene flow has been documented (Rowe 2012) between the Belle River and the St. Clair delta (including the site where *O. subrotunda* had last been seen alive) for another unionid (*Lampsilis siliquoidea*, Fatmucket) thus rescue is conceivable. However, survival is not likely because the Zebra Mussel infestation throughout Lake St. Clair has eliminated most of the suitable habitat, particularly on the southern shores near the Puce/Belle River areas (Gillis and Mackie 1994). According to Zanatta (pers. comm. 2012), "the Belle River population of *O. subrotunda* is the best I have ever seen." Transplanting of juveniles raised artificially in the lab is being proposed to help re-establish populations in historically occupied habitats in Ontario but genetic testing is still required (DFO 2013).

Quantitative Analysis:

Change in estimated probability of extirpation: yes ☐ no ☐ unk ☒

Details:

No estimate of probability of extinction was made.

Summary and Additional Considerations:

The Sydenham River Aquatic Ecosystem Recovery Strategy (SRAERS) was developed by The Sydenham River Recovery Team, the first group in Canada to adopt an ecosystem approach to recovering aquatic species, and completed in 2003 (Dextrase *et al.* 2003). The recovery strategy includes the five mussel species and nine other aquatic species (8 fishes, 1 turtle) within the basin that are assessed as endangered, threatened or special concern by COSEWIC. The Round Hickorynut was assessed after the SRAERS was completed and is therefore not directly considered within the strategy.

A recovery strategy for the Round Hickorynut was completed in 2006 (Morris 2006) but did not include descriptions of critical habitat. A new Recovery Strategy for the Round Hickorynut is being proposed by the Ontario Freshwater Mussel Recovery Team (DFO 2013) and defines critical habitat in the Sydenham River. Additional areas of potential critical habitat for this species in Lake St. Clair will be considered in collaboration with Walpole Island First Nation. A schedule of studies has been developed that outlines the necessary steps to obtain the information to further refine these critical habitat descriptions. Until critical habitat has been fully identified, the recovery team recommends that currently occupied habitats are habitats in need of conservation.

Acknowledgements and authorities contacted:

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The following people were contacted via email.

*Denotes that information was provided by authority contacted.

*McGoldrick, Daryl. February 27 2012. Water Science and Technology Branch, Environment Canada, P.O. Box 5050, Burlington, ON, Canada L7R 4A6.

*McNichols-O'Rourke, Kelly. January, February 2012. Aquatic Science Technician, Fisheries and Oceans Canada, Great Lakes Laboratory for Fisheries and Aquatic Sciences, Burlington, Ontario Department of Fisheries and Oceans, Burlington, Ontario.

*Morris, Todd. January, February 2012. Research Scientist, Fisheries and Oceans Canada, Great Lakes Laboratory for Fisheries and Aquatic Sciences, Burlington, Ontario.

*Staton, Shawn. January 2012. Species at Risk Biologist, Species at Risk Program, Central & Arctic Region, Fisheries and Oceans Canada, 867 Lakeshore Road, Burlington, Ontario L7R 4A6.

*Woolnough, Daelyn. February 2012. Research Assistant Professor, Institute for Great Lakes Research, Biology Department, Central Michigan University, Mount Pleasant, Michigan 48859 USA.

*Zanatta, David. February 2012. Assistant Professor, Institute for Great Lakes Research, Biology Department, Central Michigan University, 156 Brooks Hall, Mount Pleasant, MI 48859.

INFORMATION SOURCES

COSEWIC 2003. COSEWIC assessment and update status on the Round Hickorynut *Obovaria subrotunda* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 31 pp.

COSEWIC. 2010. COSEWIC assessment and status report on the Eastern Sand Darter *Ammocrypta pellucida*, Ontario populations and Quebec populations), in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 49 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

Dextrase, A.J., S.K. Staton,, and J.L. Metcalfe-Smith. 2003. National Recovery Strategy for species at risk in the Sydenham River: An ecosystem approach. National Recovery Plan No. 25. Recovery of Nationally Endangered Wildlife (RENEW). Ottawa, Ontario. 73 pp.

Dredging News Online. 2010. Corps of Engineers awards contract for Lake St Clair dredging project. May 3, 2010, available at: Web site: http://www.sandandgravel.com/news/article.asp?v1=12943 [accessed February 17, 2012].

Fisheries and Oceans Canada (DFO). 2013. Recovery Strategy for the Round Hickorynut (*Obovaria subrotunda*) and the Kidneyshell (*Ptychobranchus fasciolaris*) in Canada [proposed]. *Species at Risk Act* Recovery Strategy Series. Fisheries and Oceans Canada. Ottawa. 74 pp.

Fisheries and Oceans Canada (DFO). 2012. Recovery strategy for the Eastern Sand Darter (*Ammocrypta pellucida*) in Canada: Ontario populations. *Species at Risk Act* Recovery Strategy Series, Fisheries and Oceans Canada, Ottawa. vii + 58 pp.

French, J.R.P., and D.J. Jude. 2001. Diets and diet overlap of nonindigenous gobies and small native fishes co-habitating the St. Clair River, Michigan. Journal of Great Lakes Research 27:300-311.

Gagné, F., C. Blaise, and J. Hellou. 2004. Endocrine disruption and health effects of caged mussels, *Elliptio complanata*, placed downstream from a primary-treated municipal effluent plume for 1 year. Comparative Biochemistry and Physiology C 138:33-44.

Gagné F., B. Bouchard, C. André, E.F. Farcy, and E.M. Fournier. 2011. Evidence of feminization in wild *Elliptio complanata* mussels in the receiving waters downstream of a municipal effluent outfall. Comparative Biochemistry and Physiology C 153:99–106

Gagnon, C., F. Gagné, P. Turcotte, I. Saulnier, C. Blaise, M. Salazar, and S. Salazar. 2006. Metal exposure to caged mussels in a primary-treated municipal wastewater plume. Chemosphere 62:998-1010.

Gillis, P.L. 2011. Assessing the toxicity of sodium chloride to the glochidia of freshwater mussels: Implications for salinization of surface waters. Environmental Pollution 159(6):1702-1708.

Gillis, P.L., and G.L. Mackie. 1994. Impact of the Zebra Mussel, *Dreissena polymorpha*, on populations of Unionidae (Bivalvia) in Lake St. Clair. Canadian Journal of Zoology 72:1260-1271.

Gillis, P.L., J.C. McGeer, G.L. Mackie, M.P. Wilkie, and J.D. Ackerman. 2010. The effect of natural dissolved organic carbon on the acute toxicity of copper to larval freshwater mussels (glochidia). Environmental Toxicology and Chemistry 29(11):2519–2528,

Gillis, P.L., R.J. Mitchell, A.N. Schwalb, K.A. McNichols, G.L. Mackie, C.M. Wood, and J.D. Ackerman. 2008. Sensitivity of glochidia (larvae) of freshwater mussel to copper: Assessing the effect of water hardness and dissolved organic carbon on the sensitivity of endangered species. Aquatic Toxicology 88:137-145.

Holm, E., and N.E. Mandrak. 1996. The status of the Eastern Sand Darter, *Ammocrypta pellucida* in Canada. Canadian-Field Naturalist 110(3):462-469.

Mackie, G.L. 2004. Mussel collection, relocation and monitoring at Delcan's Airport Road Bridge construction site. Final report to Delcan Corporation and City of London, July 2004. 2 pp.

Mackie, G.L. 2006a. Relocation of mussels in the Grand River at Highway 8 in Kitchener, Ontario. Prepared for Thurber Engineering Inc., October 2006. 7 pp.

Mackie, G.L. 2006b. Collection and relocation of mussels in Medway Creek at Fox Hollow. Prepared for Stantec, September 2006, 15 pp.

Mackie, G.L. 2006c. Visual searches and relocations of mussels in Medway Creek North of Fanshawe Park Road in London Ontario. Prepared for Stantec, September 2006, 6 pp.

Mackie, G.L. 2007a. Collection and Relocation of Mussels in Medway Creek at Fox Hollow. Prepared for Stantec, July 2007. 10 pp.

Mackie, G.L. 2007b. Relocation of mussels in Grand River at Inverhaugh. Final report prepared for Ministry of Natural Resources, August 2007, 10 pp.

Mackie, G.L. 2008a. Relocation of mussel species at risk in the Grand River at Bridge Street. Prepared for Region of Waterloo and Stantec, Project 5816, July 2008, 21 pp.

Mackie, G.L. 2008b. Detection of Mussel Species at Risk in the Sydenham River at the Dismar-Wallaceburg Site. Final report for Wallaceburg Community Task Force, Chatham-Kent Economic Development Services. August 31, 2008. 15 pp.

Mackie, G.L. 2009. Final report for mussel relocation in Grand River at Highway 8 near Kitchener (Project MTO 2008-3023). Prepared for BOT Construction, July 2009, 20 pp.

Mackie, G.L. 2010a. Final report for mussel relocation at three sites in Medway Creek North of Fanshawe Park Road in London, Ontario. Project No. 161403262, July 27, 2010, 29 pp.

Mackie, G.L. 2010b. Final report for relocating mussels in Grand River at Fairway Road extension in Kitchener and Cambridge, Ontario. Project No. 50-3239, phase 5. Prepared for Ecoplans and Region of Waterloo, September 1, 2010, 16 pp.

Mackie, G.L. 2010c. Survey of mussel species at risk for a bridge structure replacement at North Thames River and a structural culvert replacement at Highway 23. MTO Group Work Project Number: 3043-06-00. September 14, 2010, 11 pp.

Mackie, G.L. 2010d. Site survey for mussel species at risk in the Grand River at York, Ontario. Report to Grand River Conservation Authority, Cambridge, Ontario. 2 pp.

Mackie, G.L. 2011. Final report for the relocation of mussels in the Thames River in preparation for a new bridge in Dorchester, Ontario. Prepared for Corporation of County of Middlesex, September 3, 2011. 46 pp.

Mackie, G.L., and R. Claudi. 2010. Monitoring and control of macrofouling mollusks in fresh water systems, Second Edition. CRC Press, Boca Raton, Florida. 508 pp.

McGoldrick, D.L., J. Metcalfe-Smith, M.I.T. Arts, D.W. Schloesser, T.J. Newton, G.L. Mackie, E.M. Monroe, J. Biberhofer, and K. Johnson. 2009. Characteristics of a refuge for native freshwater mussels (Bivalvia: Unionidae) in Lake St. Clair. Journal of Great Lakes Research 35:137-146.

McGoldrick, D., pers. comm. 2012. *Email correspondence with G. Mackie.* February 27 2012. Water Science and Technology Branch, Environment Canada, P.O. Box 5050, Burlington, Ontario, Canada L7R 4A6.

McNichols-O'Rourke, K., pers. comm. 2012. *Email correspondence with G. Mackie.* 26 January, 10 February 2012. Aquatic Science Technician, Fisheries and Oceans Canada, Great Lakes Laboratory for Fisheries and Aquatic Sciences, Burlington, Ontario Department of Fisheries and Oceans, Burlington, Ontario.

McNichols, K.A., 2007. Implementing recovery strategies for mussel species at risk in Ontario. M.Sc. Thesis, University of Guelph, pp. 171.

Metcalfe-Smith, J.L., D.J. McGoldrick, M. Williams, D.W. Schloesser, J. Biberhofer, G.L. Mackie, M.T. Arts, D.T. Zanatta, K. Johnson, P. Marangelo, and T.D. Spencer. 2004. Status of a refuge for native freshwater mussels (Unionidae) from the impacts of the exotic Zebra Mussel (*Dreissena polymorpha*) in the delta area of Lake St. Clair. Environment Canada, National Water Research Institute, Burlington, Ontario. Technical Note No. AEI-TN-04-001. 48 pp.

Morowski, D., L.J. James, and R.D. Hunter. 2009. Freshwater mussels of the Clinton River, southeastern Michigan: an assessment of Community status. Michigan Academician 39 (pending publication). Xcel data sheet, "Raw data for the 2004 freshwater mussel survey of the Clinton River", available at Web site: http://dspace.oakland.edu:8080/dspace/handle/10323/163 [accessed February 17, 2012].

Morris, T.J. 2006. Recovery Strategy for the Round Hickorynut (*Obovaria subrotunda*) and the Kidneyshell (*Ptychobranchus fasciolaris*) in Canada. Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada. Ottawa. 47 pp.

Morris, T.J., pers. comm. 2012. *Email correspondence with G. Mackie.* 3 February, 2012. Research Scientist, Fisheries and Oceans Canada, Great Lakes Laboratory for Fisheries and Aquatic Sciences, Burlington, Ontario.

Morris, T.J., and A. Edwards. 2007. Freshwater mussel communities of the Thames River, Ontario: 2004-2005. Canadian Manuscript Report of Fisheries and Aquatic Sciences 2810: v + 30 pp.

Mummert, A.K., R.J. Neves, T.J. Newcomb, and D.S. Cherry. 2003. Sensitivity of juvenile freshwater mussels (*Lampsilis fasciola, Villosa iris)* to total and unionized ammonia. Environmental Toxicology and Chemistry 22:2545-2553.

Nalepa, T.F., and J.M. Gauvin. 1988. Distribution, abundance, and biomass of freshwater mussels (Bivalvia: Unionidae) in Lake St. Clair. Journal of Great Lakes Research 14(4):411-419.

Nalepa, T.F., D.J. Hartson, D.L. Fanslow, and G.A. Lang. 2001. Recent population changes in freshwater mussels (Bivalvia: Unionidae) and Zebra Mussels (*Dreissena polymorpha*) in Lake St. Clair, U.S.A. American Malacological Bulletin 16:141–145.

Nalepa, T.F., D.J. Hartson, G.W. Gostenik, D.L. Fanslow, and G.A Lang. 1996. Changes in the freshwater mussel community of Lake St. Clair: from Unionidae to *Dreissena polymorpha* in eight years. Journal of Great Lakes Research 22:354-369.

Newton, T.J. 2003. The effects of ammonia on freshwater unionid mussels. Environmental Toxicology and Chemistry 22:2543-2544.

Newton, T.J., J.W. Allran, J.A. O'Donnell, M.R. Bartsch, and W.B. Richardson. 2003. Effects of ammonia on juvenile unionid mussels (*Lampsilis cardium*) in laboratory sediment toxicity tests. Environmental Toxicology and Chemistry 22: 2554-2560.

Newton, T.J., and M.R. Bartsch. 2007. Lethal and sublethal effects of ammonia to juvenile *Lampsilis* mussels (Unionidae) in sediment and water-only exposures. Environmental Toxicology and Chemistry 26: 2057-2065.

OMNR (Ontario Ministry of Natural Resources). 2011. Oil, Gas and Salt Resources. Crude Oil and Natural Gas Resources, available at: Web site: http://www.mnr.gov.on.ca/en/Business/OGSR/2ColumnSubPage/STEL02_167105.html [accessed February 17, 2012].

Poos, M.A., A.J. Dextrase, A.N. Schwalb, and J.D. Ackerman. 2010. Secondary invasion of the round goby into high diversity Great Lakes tributaries and species at risk hotspots: potential new concerns for endangered freshwater species. Biological Invasions 12:1269–1284.

Rowe, M.T. 2012. The genetic structure of remnant Fatmucket mussel (*Lampsilis siliquoidea*) populations in the St. Clair River delta and surrounding tributaries following the invasion of dreissenid mussels. M.Sc. Thesis, Central Michigan University, Mount Pleasant, Michigan. x + 32 pp.

Spooner, D., M. Xenopoulos, C. Schneider, and D. Woolnough. 2011. Co-extirpation of host-affiliate relationships in rivers: the role of climate change, water withdrawal, and host-specificity. Global Change Biology 17(4):1720.

Staton, S., pers. comm. 2011. *Email correspondence with G. Mackie*. 13 December 2011. Species at Risk Biologist, Species at Risk Program, Central & Arctic Region, Fisheries and Oceans Canada, 867 Lakeshore Road, Burlington, Ontario L7R 4A6.

Staton, S.K., A. Dextrase, J.L. Metcalfe-Smith, J.Di Maio, M. Nelson, Paris Geomorphic Ltd., B. Kilgour, and E. Holm. 2003. Status and trends of Ontario's Sydenham River ecosystem in relation to aquatic species at risk. Ecological Monitoring and Assessment 88:283-310.

Thomas, M.V., and R.C. Haas. 2004. Status of Lake St. Clair fish community and sport fish,1996-2004. Michigan Department of Natural Resources, Fisheries Division. Fisheries Research Report 2067. 26 pp.

Tremblay, M. 2012. The invasive round goby (*Neogobius melanostomus*) as a host for endangered unionid mussels Bivalvia: Unionidae). M.Sc. Thesis, University of Guelph, 90 pp.

Turgeon, D.D., J.F. Quinn, Jr., A.E. Bogan, E.V. Coan, F.G. Hochberg, W.G. Lyons, P.M. Mikkelsen, R.J. Neves, C.F.E. Roper, G. Rosenberg, B. Roth, A. Scheltema, F.G. Thompson, M. Vecchione, and J.D. Williams. 1998. Common and scientific names of aquatic invertebrates from the United States and Canada: Mollusks, second edition. American Fisheries Society Special Publication 26, American Fisheries Society, Bethesda, Maryland. ix + 526 pp.

Woolnough, D., pers. comm. 2012. *Email correspondence with G. Mackie*. 17 February 2012. Research Assistant Professor, Institute for Great Lakes Research, Biology Department, Central Michigan University, Mount Pleasant, Michigan 48859 USA.

Zanatta, D., pers. comm. 2012, 2013. *Email correspondence with G. Mackie and later D. Lepitzki*. 17 February 2012, 24 April 2013. Assistant Professor, Institute for Great Lakes Research, Biology Department, Central Michigan University, 156 Brooks Hall, Mount Pleasant, MI 48859.

Zanatta, D.T., G.L. Mackie, J.L. Metcalfe-Smith, and D.A. Woolnough. 2002. A refuge for native freshwater mussels (Bivalvia: Unionidae) from impacts of the exotic Zebra Mussel (*Dreissena polymorpha*) in Lake St. Clair. Journal of Great Lakes Research 28(3):479-489.

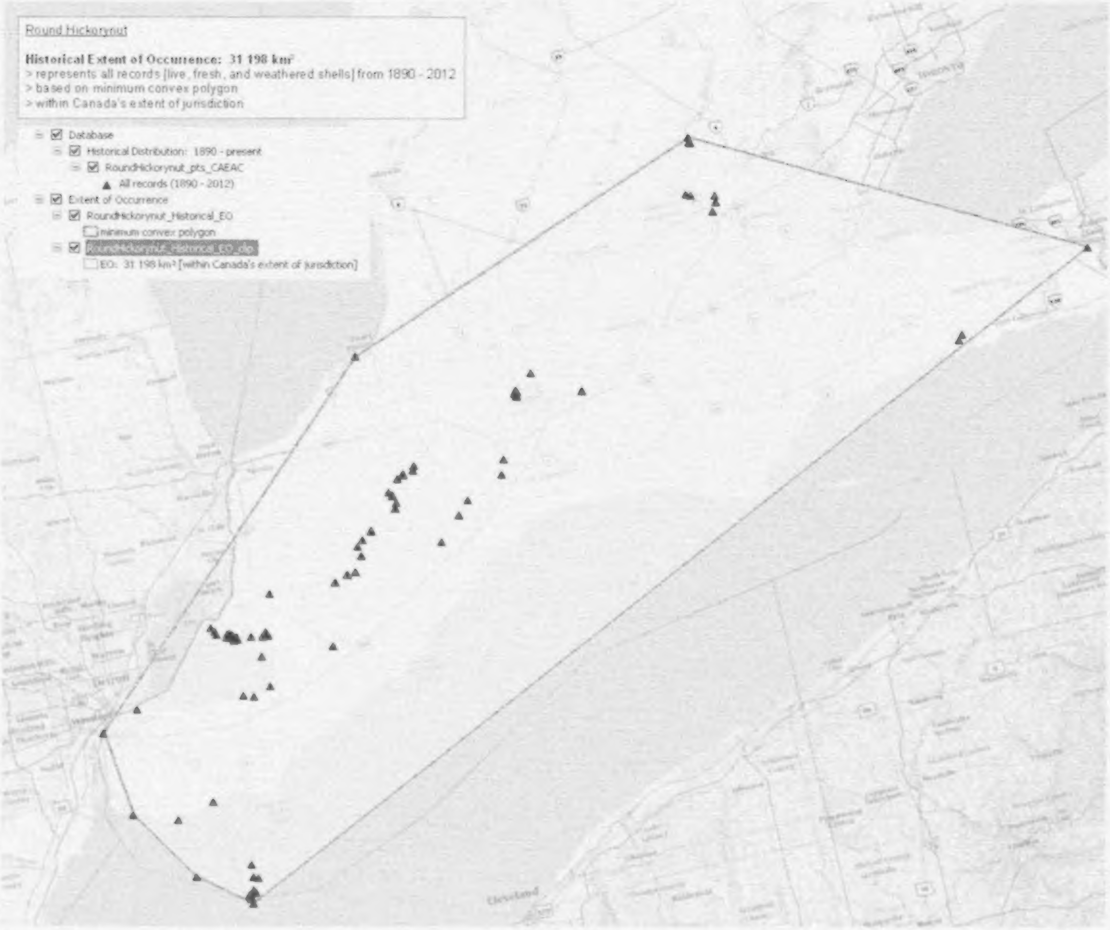

Figure 1. Historical extent of occurrence of *Obovaria subrotunda*: shows all records (live, fresh, and weathered shells) from 1890 to 2012, based on minimum convex polygon within Canada's extent of jurisdiction.

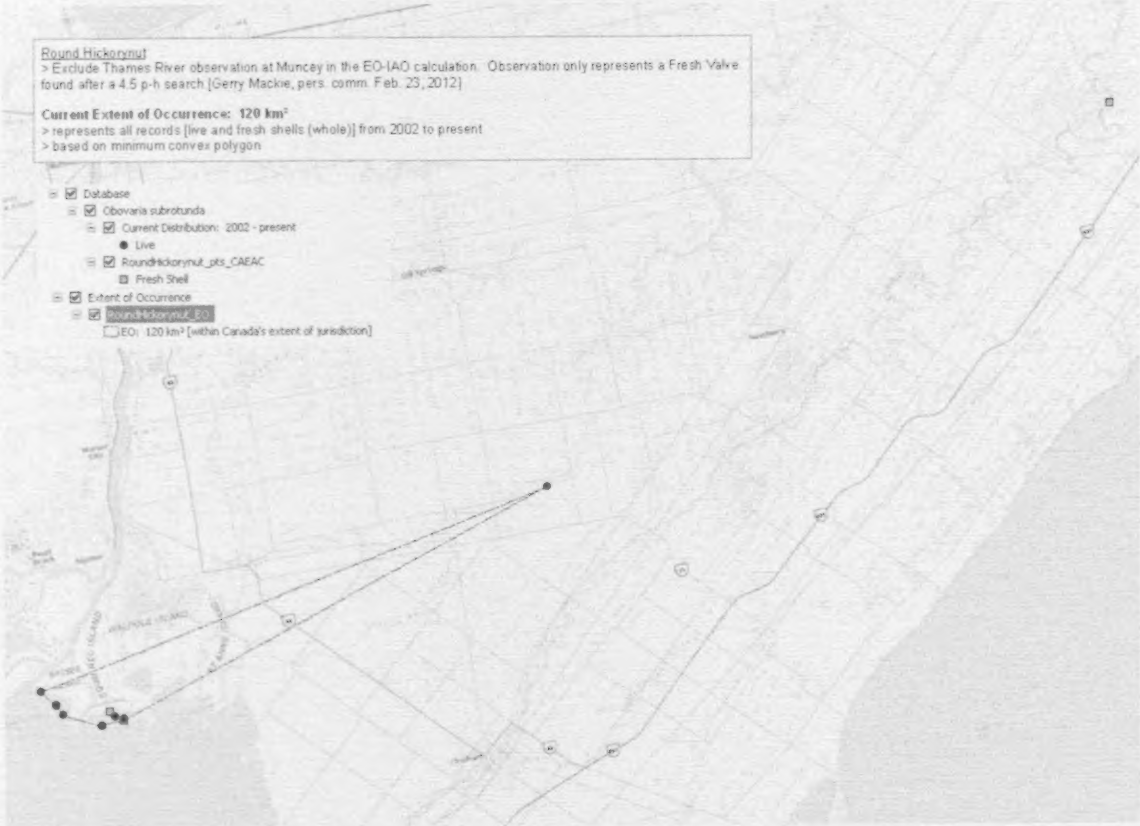

Figure 2. Current extent of occurrence of *Obovaria subrotunda*, showing live and fresh shells (whole) from 2002 to present, based on minimum convex polygon.

Figure 3. Historical index of area of occupancy (2 km x 2 km grids): 26 grids = 164 km² based on one grid around each observation [live and fresh shells (whole)].

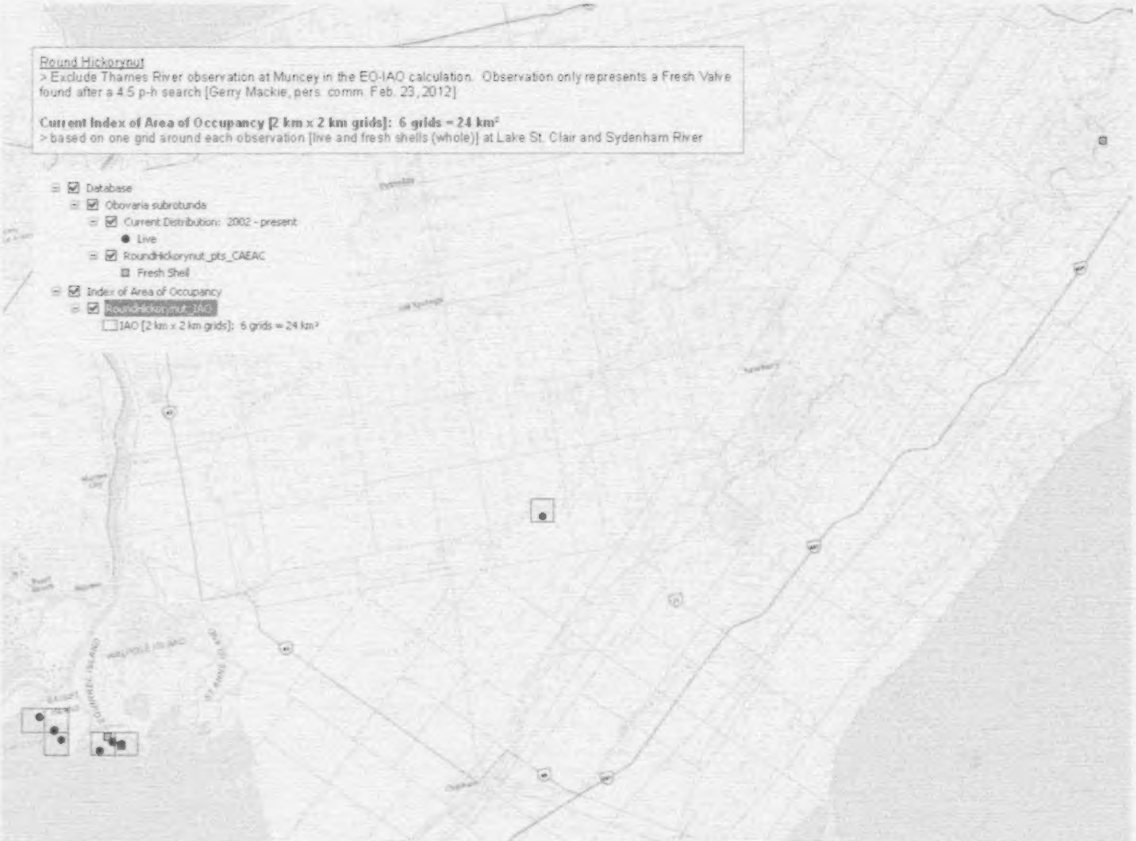

Figure 4. Current index of area of occupancy [2 km x 2 km grids] of *Obovaria subrotunda:* 6 grids = 24 km², based on one grid around each observation [live and fresh shells (whole)] at Lake St. Clair and Sydenham River.

Appendix 1. Threat calculator results for *Obovaria subrotunda*

Threat No.	Threat Description	Threat Impact		Scope	Severity	Timing	Comments
2	Agriculture & aquaculture		Negligible	Negligible (< 1%)	Extreme (71-100%)	High (Continuing)	
2.3	Livestock farming & ranching		Negligible	Negligible (< 1%)	Extreme (71-100%)	High (Continuing)	Cattle entering streams resulting in trampling of mussels
3	Energy production & mining	D	Low	Small (1-10%)	Moderate (11-30%)	Moderate - Low	
3.1	Oil & gas drilling	D	Low	Small (1-10%)	Moderate (11-30%)	Moderate - Low	Sydenham River watershed has numerous oil rigs
4	Transportation & service corridors	C	Medium	Restricted (11-30%)	Serious (31-70%)	Moderate	
4.3	Shipping lanes	C	Medium	Restricted (11-30%)	Serious (31-70%)	Moderate (Possibly in the short term, < 10 yrs/3 gen	Lake St. Clair is a shipping lane to Detroit and St. Clair rivers; shipping lane is dredged periodically
5	Biological resource use	CD	Medium - Low	Large - Small (1-70%)	Moderate - Slight (1-30%)	Moderate - Low	
5.4	Fishing & harvesting aquatic resources	CD	Medium - Low	Large - Small (1-70%)	Moderate - Slight (1-30%)	Moderate - Low	Bait fishing/capturing common in both locations
6	Human intrusions & disturbance	D	Low	Restricted (11-30%)	Moderate (11-30%)	Moderate (Possibly in the short term, < 10 yrs/3 gen	
6.1	Recreational activities	D	Low	Restricted (11-30%)	Moderate (11-30%)	Moderate (Possibly in the short term, < 10 yrs/3 gen	ATVs in Sydenham River
8	Invasive & other problematic species & genes	A	Very High	Pervasive (71-100%)	Extreme (71-100%)	High (Continuing)	
8.1	Invasive non-native/alien species	A	Very High	Pervasive (71-100%)	Extreme (71-100%)	High (Continuing)	Dreissenids kill unionids and Round Goby out compete fish hosts; common in both populations
9	Pollution	A	Very High	Pervasive (71-100%)	Extreme (71-100%)	High (Continuing)	
9.1	Household sewage & urban waste water	B	High	Large (31-70%)	Serious (31-70%)	High (Continuing)	Runoff from streets carries PAHs & other organic contaminants; sediments; thermal pollution; both populations receive runoff and/or end up in L. St. Clair
9.3	Agricultural & forestry effluents	A	Very High	Pervasive (71-100%)	Extreme (71-100%)	High (Continuing)	Most farms are tiled (> 60%) and carry nutrients, sediments, bacteria, etc. to outfalls; all end up in L. St. Clair
11	Climate change & severe weather	B	High	Pervasive (71-100%)	Serious (31-70%)	High (Continuing)	
11.1	Habitat shifting & alteration	B	High	Pervasive (71-100%)	Serious (31-70%)	High (Continuing)	High flows erode habitats; low flows cause desiccation, higher temperatures, low oxygen
11.2	Droughts	B	High	Pervasive (71-100%)	Serious (31-70%)	High (Continuing)	See 11.1
11.3	Temperature extremes	B	High	Pervasive (71-100%)	Serious (31-70%)	High (Continuing)	See 11.1
11.4	Storms & flooding	B	High	Pervasive (71-100%)	Serious (31-70%)	High (Continuing)	See 11.1

TECHNICAL SUMMARY

Obovaria subrotunda
Round Hickorynut — Obovarie ronde
Range of occurrence in Canada : Ontario

Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines(2008) is being used)	Unknown, estimate 10 yr life span, so 3 generations is < 30 yr
Is there an inferred continuing decline in number of mature individuals? Inferred from declines in population sizes	Probably
Estimated percent of continuing decline in total number of mature individuals within 2 generations. Population sizes are declining but % of mature individuals unknown	Unknown
Inferred percent reduction in total number of mature individuals over the last 10 years. Population sizes are declining although total number of mature individuals is unknown, juveniles are rarely found so most of the densities probably relate to mature individuals	Between 75% and 95%
Projected percent reduction in total number of mature individuals over the next 10 years. >75% reduction in population sizes but proportion of mature individuals unknown	Unknown
[Inferred percent reduction in total number of mature individuals over any 10 year, period, over a time period including both the past and the future. Most individuals are probably mature adults because juveniles are rarely found.	Between 75% and 95% over last 10 yrs. Over 30 years estimated at 99%
Are the causes of the decline clearly reversible and understood and ceased?	No, Yes, and No
Are there extreme fluctuations in number of mature individuals?	Unknown

Extent and Occupancy Information

Estimated extent of occurrence (see Figure 2)	120 km^2
Index of area of occupancy (IAO) (Based on 2 km x2 km grid, see Figure 4).	24 km^2
Is the total population severely fragmented?	No
Number of locations∗ Portion of Lake St. Clair delta and East Sydenham River with the river flowing into Lake St. Clair; based on very high and high impact threats	1-2
Is there an observed continuing decline in extent of occurrence?	Yes
Is there an observed continuing decline in index of area of occupancy?	Yes
Is there an observed continuing decline in number of populations?	Yes
Is there an observed continuing decline in number of locations*? Definition of location has changed over last 10 years; previous 10 yrs was 2 locations, currently there is 1 location	No
Is there an observed continuing decline in area, extent and quality of habitat?	Yes for area, extent, and quality
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations∗?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

∗ See Definitions and Abbreviations on COSEWIC website and IUCN 2010 for more information on this term.

Number of Mature Individuals (in each population)

Population	N Mature Individuals
East Sydenham River Not found alive in surveys between 2002 and 2009 but one was found alive in 2012	At least 1
Lake St. Clair delta (decline of 75-98.5% population size since 2001); ~55,000 reported for 2001 and if majority are mature individuals, estimate is now:	825-13,750
Total	<13,750

Quantitative Analysis

Probability of extinction in the wild is at least 20% within 20 years. Not known (no information on birth rate, death rate, demographic variation, temporal variation, etc. BUT in Lake St. Clair, decline from 1991 to 2001 was 90%; decline from 2003 to 2011 was 75-98.5%. Likelihood of remaining 1.5-25% is unknown.	Unknown

Threats (actual or imminent, to populations or habitats)

Very high impact threats include pollution (urban, agricultural, industrial effluents, road runoff) and invasive species (dreissenids and Round Goby). A high impact threat is climate change (e.g., affects water quantity) and a medium impact threat is dredging of shipping lanes. A medium-low impact threat is biological resource use (e.g., declines in host fishes). Low impact threats include energy production (e.g., oil drilling) and human intrusions and disturbance.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)? U.S.A. SRanks: SX in Illinois; S1 in Arkansas, Indiana, Michigan, Pennsylvania; S2 in Alabama, Mississippi: S3 in West Virginia; S4 in Ohio; SH in Georgia, New York; S2S3 in Tennessee; S3S5 in Kentucky. The Round Hickorynut is currently assessed as endangered in Illinois, Michigan, and Alabama (and proposed for endangered in Pennsylvania), threatened in Tennessee, and special concern in Indiana.	
Is immigration known or possible? Michigan a potential rescue to lake St. Clair population	Yes, possible
Would immigrants be adapted to survive in Canada? Lake St. Clair is infested with Zebra Mussels and Round Goby and unionids cannot compete with these invasive species	Probably not
Is there sufficient habitat for immigrants in Canada? Habitat available in Lake St. Clair delta only; all nearshore habitats infested with Zebra Mussels and not likely to reach the delta.	Yes, but restricted to delta
Is rescue from outside populations likely?	No

Data Sensitive Species

Is this a data sensitive species?	Yes

Status History

Designated Endangered in May 2003. Status re-examined and confirmed in May 2013.

Status and Reasons for Designation

Status: **Endangered**	**Alpha-numeric Code:** A2ace; B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)
Reasons for Designation: The Canadian population of this species has declined by 75-95% over the past 10 years, with an estimated 99% decline over the last 30 years. Populations in the Grand and Thames rivers are extirpated and populations in the Sydenham River and Lake St. Clair have declined to very low levels. Losses and declines are due to the combined effects of pollution from agriculture and residential runoff, and the impacts of invasive species like the Zebra Mussel.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Meets A2 for Endangered. Subcriterion (a), (c) and (e) are applicable as there (a) has been a decline in the total population of between 75% and 95% and (c) a decline in EO of 92% over the past 10 years caused by the effects of introduced taxa and pollution (e). Although the causes for the decline are understood, they have not ceased and are not easily reversible. Declines over 3 generations would be larger.
Criterion B (Small Distribution Range and Decline or Fluctuation): EO and IAO are well below thresholds for Endangered (B1 and B2) and meets "a" (fewer than 5 locations). Because there is an observed continuing decline in EO; IAO; area, extent and quality of habitat; number of populations; and number of mature individuals due to invasive species and agricultural and urban pollution subcriteria i, ii, iii, iv, and v under (b) are all applicable.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable
Criterion D (Very Small or Restricted Total Population): D2 Threatened is applicable as there are fewer than 5 locations and the species is prone to the effects of human activities that can rapidly alter required habitat within a very short time.
Criterion E (Quantitative Analysis): Not done

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2013)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

Environment Canada / Environnement Canada
Canadian Wildlife Service / Service canadien de la faune

Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.